Spectrometer Magnet Analysis

Logic interpretation

Fri, May 31, 2002

The serial port interface from node061E delivers a 12-character reading at 9600 baud about once per second. The reading is in units of Tesla, expressed in floating point, such as "L0.7408665T" followed by a carriage return character. The "L" indicates locked status, and the "T" indicates that the units are Tesla. The LOOPSPEC program expects to find both the locked and Tesla characters present.

The program samples a number of consecutive readings, copying each value to device SPECR, which then is copied to device SPEC. After it collects the specified number, which is not allowed to be more than 32, it averages all the results to produce device SPECT and compares that average value with the nominal value, which is the alarm-related nominal value of SPEC. As a result, the check against the nominal value is made about once in 32 seconds max. (The SPNAV device holds this number. Its current value is 53, so the program uses its maximum value of 32.) If the difference is more than a threshold value, which is in device SPTHR, it adjusts the fine-control D/A by plus or minus 1.0 gauss. There is a coarse control channel, SPECCR, for which the setting full-scale is about 12 times larger than the setting full-scale for SPEC, so that indicates the relative sensitivity between coarse and fine D/As. The hardware must somehow sum the outputs of these two D/As. The program itself does not do anything with the coarse control D/A; it only adjusts the fine control D/A.

You can see the readings obtained from the serial port interface updated at 1 Hz in SPEC. The program adjusts this same channel when it needs to make an adjustment, but it only adjusts up or down by 1 gauss. With the present parameter values, this occurs about twice a minute, unless the average reading is within the threshold of the nominal value, in which case the program makes no adjustment at all, but merely begins a new sequence of collecting readings from the hardware at 1 Hz.

The full-scale for SPEC is 10008 gauss, which only means it is enough breathing room to show a 10000 gauss value. The program works in gauss in floating point. When it makes a setting, it does so in floating point, and the low level routines use the full-scale values to convert it into a 16-bit integer for internal use. Whenever you see it, that value is scaled with the scale factor of that channel to produce what you see. As long as the scale factors are the same between the reading and setting, everything will work out. The full-scale values for SPEC, SPECT and SPECR are all equal.

When a 1 gauss adjustment is made to the fine control D/A, the D/A change in volts is about 0.012 volts. This should make an adjustment of 2 or 3 least significant bits of that D/A, since it is a 12-bit D/A whose least bit represents about 0.005 volts. this just means that the adjustments made are almost, but not quite, the smallest adjustments possible.

If it should happen that the fine control range is exceeded, then you would expect to see an alarm, I think. If this means the coarse control must be adjusted, then it must be done manually, so that the fine control is again working within its range. You can see whether its range is being threatened by looking at device SPECF, which shows the fine

control in units of D/A volts. I suppose it would be ideal if that value were in the middle of its range. Now, since a D/A output can vary from –10 v to +10 v, you might think that 0 volts is a good middle of the range. But I understand that Larry Allen prefers to set the coarse control, so that the middle of the range is +5 volts. Whether the fine control could validly take on a negative value depends upon whether the hardware that sums the analog coarse and fine voltages is compatible with the fine control being a negative voltage. (Mathematics may say it's ok, but one also has to recognize the realities of the hardware.)

Ok, so you try to set it up so that the fine control is around +5 volts. But recognize that the program takes a rather leisurely attitude about producing an average reading that it can compare with the nominal and make a small adjustment in the right direction. In order that one doesn't have to wait all afternoon, it may be smart to change the `SPNAV` device to a smaller value so that adjustments are made more often until it all stabilizes and you can get a better estimate of where the fine control settles out. At the end of making one average calculation, the program grabs the latest value of that device to decide how many points to use in its next average. If you changed the value of `SPNAV` to 1, it should make adjustments as often as 1 Hz, albeit with a non-averaged reading of the spectrometer field.